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Indian Standard

SPECIFICATION FOR CERAMIC COMPONENTS FOR THERMOCOUPLES AND RESISTANCE THERMOMETERS

PART I TERMINAL BLOCKS

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Indian Standard

SPECIFICATION FOR CERAMIC COMPONENTS FOR THERMOCOUPLES AND RESISTANCE THERMOMETERS

PART I TERMINAL BLOCKS

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SPECIFICATION FOR CERAMIC COMPONENTS FOR THERMOCOUPLES AND RESISTANCE THERMOMETERS

PART I TERMINAL BLOCKS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 28 June 1977, after the draft finalized by the Electrical Instruments for Industrial Processes Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Components made of ceramics (for example, porcelain) are largely used in the manufacture of terminal blocks used for thermocouples and resistance thermometers. Standardization of main dimensions of components has been considered desirable for necessary interchangeability. However, in view of a large variety of components being manufactured to different dimensions depending upon different applications, it has been considered rather difficult to standardize main dimensions at present. This standard has, therefore, been drawn up to lay down dimensional accuracies, certain minimum requirements and tests for such components.

0.3 In the preparation of this standard, considerable assistance has been derived from ILS 8-1969 ‘ Plant standard-porcelain components for use up to 500 V ’, issued by the Instrumentation Ltd, Kota.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part I) covers requirements and dimensional accuracies for ceramic components, such as terminal blocks for thermocouples and resistance thermometers.

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*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, definitions given in IS : 2781-1964* and the following shall apply.

2.1 Spots — Spots of greyish black or faint bluish colour which appear on the surface of the ceramic components.

2.2 Cracks — Opening appearing on the surface of the components.

2.3 Obstruction — Particles of chamot, conglomerations and accumulations which appear on the surface of the components.

2.4 Pitting — Defects characterized by depressions on the body of the component caused as a result of burning or inclusion of foreign matter in the body of the component.

2.5 Dents and Chipping — Defects characterized by material breaking off from face ends.

3. TYPES

3.1 The ceramic components shall be of one of the following types:

Type A — With close tolerances, and
Type B — With relaxed tolerances.

4. EXTERNAL APPEARANCE

4.1 Depending upon the external appearance, the ceramic components shall conform to the properties specified in Table 1.

5. DEFECTS

5.1 Total defects of the components as characterized in Table 1 shall not exceed the values given in Table 2.

6. DIMENSIONAL ACCURACY

6.1 Non-circular Components — For nominal dimensions of the component, maximum allowable tolerances on length, width and thickness of the wall shall be as given in Table 3.

6.2 Circular Components — For nominal dimensions of the component, maximum allowable tolerances on diameters shall be as given in Table 4.

6.3 Hole Dimensions — Maximum allowable tolerances on dimensions of holes shall be as given in Table 5.

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*Glossary of terms relating to ceramicware.

TABLE 1 EXTERNAL APPEARANCE

[*Clauses* 4.1, 5.1, 8.2 (a) *and* 8.3.2]

SL No.	PROPERTY	CHARACTERISTIC
(1)	(2)	(3)
i)	Colour	White with yellowish or greyish tinge
ii)	Bubbles	Open bubbles, closed bubbles: solitary and scattered up to 1 mm diameter are permissible
iii)	Spots	Scattered spots of diameter less than 0·5 mm and solitary spots of diameter less than 2 mm are permissible. No iron spot is permissible
iv)	Cracks	Cracks on important places and surfaces are not permissible. The important places shall be indicated on the drawings. Cracks up to a width of 0·5 mm and length 10 mm are permissible at unimportant places
v)	Obstruction	Not permissible
vi)	Dents and Chipping	Dents or chipping having length up to 5 mm, depth up to 1 mm and diameter up to 1 mm are permissible such that the dimensions of the components are within the limits of tolerances
vii)	Pitting	Scattered burns and melts of depth and diameter less than 1 mm are permissible

TABLE 2 ALLOWABLE DEFECTIVE SURFACE AREA

(*Clause* 5.1)

SURFACE AREA OF THE COMPONENT		ALLOWABLE TOTAL DEFECTIVE SURFACE AREA, *Max*
Over	Up to and Including	
(1)	(2)	(3)
cm^2	cm^2	
10	30	0·5 cm^2
30	60	0·8 cm^2
60	100	1·0 cm^2
100		1·0 percent

6.4 Rounding Radius — Rounding of the ribs with a radius of not more than 2 mm is permissible, irrespective of the method of manufacture of the component.

6.5 Non-parallelism — Maximum allowable tolerances on non-parallelism of the plane surfaces shall be as given in Table 6.

TABLE 3 TOLERANCES ON LENGTH, WIDTH AND THICKNESS

(*Clauses* 6.1 *and* 6.9)

Nominal Dimension of the Component		Allowable Tolerances on Length, Width and Thickness of Wall, *Max*	
Over	Up to and Including	Type A	Type B
(1)	(2)	(3)	(4)
mm	mm		
3	5	±0·3 mm	±0·5 mm
5	10	±0·4 mm	±0·5 mm
10	20	±0·4 mm	±0·7 mm
20	30	±0·5 mm	±1·0 mm
30	50	±0·6 mm	±1·0 mm
50	80	±0·8 mm	± 3·5 percent but not more than ±5 mm for values above 50 mm
80	120	±1·0 mm	
120	180	±1·2 mm	
180		±1·5 mm ±1·0 percent	

Note 1 — For unimportant dimensions above 10 mm which do not affect th assembly, the allowable tolerances may be higher than those specified but not mor than twice these values.

Note 2 — Ovality of the component and also local non-uniformity of the surfac shall not make the component cross the dimensions beyond the limits of allowabl tolerances.

Note 3 — Slope of all the vertical surfaces of the component shall not make it dimensions at the edges beyond the limits of allowable tolerances.

6.6 Warp

6.6.1 *Flat Surfaces* — Maximum allowable warp in the flat surface o the component shall be as given in Table 7.

6.6.2 *Bearing Surface of Component* — Maximum allowable warp in th bearing surface or seat of the component shall be as given in Table 8.

6.7 All dimensions of the component along with the tolerances shall b indicated on the drawing.

6.8 Wherever required by conditions of assembly of the components, close tolerances may be obtained by additional operations, for example grinding which shall be specified in the specifications of the particula component.

TABLE 4 TOLERANCES ON DIAMETER

(*Clauses* 6.2 *and* 6.9)

Nominal Diameter of the Component		Allowable Tolerances on Diameter (External or Internal), *Max*	
Over	Up to and Including	Type A	Type B
(1)	(2)	(3)	(4)
mm	mm		
3	5	±0·4 mm	±0·7 mm
5	10	±0·4 mm	±0·7 mm
10	20	±0·5 mm	±1·0 mm
20	30	±0·6 mm	±1·0 mm
30	50	±0·7 mm	±3·5 percent but not more than ±5 mm for values above 30 mm
50	80	±1·0 mm	
80	120	±1·2 mm	
120	180	±1·5 mm	
180		±1·0 percent	

Note 1 — For unimportant dimensions above 10 mm which do not affect the assembly, the allowable tolerances may be higher than those specified but not more than twice these values.

Note 2 — Ovality of the component and also local non-uniformity of the surface shall not make the component cross the dimensions beyond the limits of allowable tolerances.

Note 3 — Shift in the centres of the concentrically placed curvatures shall not exceed half the allowable tolerance on diameter of the maximum curvature.

6.9 The surfaces of the components which have to be glazed should be coated with a uniform layer of white or coloured glazer. Difference in the tinge of the glaze is permissible. Any non-uniformity of the glazer that does not make the component cross the tolerances specified in Tables 3, 4 and 5 is permissible. Crackle of the glazer is not allowed. Places which touch or have a bearing during sintering are not glazed.

6.10 Components which are threaded with themselves or with metallic components shall have correct and clean threads monolithic with the body of the ceramic.

7. PACKING, STORAGE AND MARKING

7.1 Packing — The components shall be packed in wooden cases, crates, bamboo baskets or containers, interlaid with soft packing material like straw, chaff or corrugated paper, etc, so that during transportation, the components do not collide and are preserved from mechanical damage.

TABLE 5 TOLERANCES ON HOLE DIMENSIONS

(*Clauses* 6.3 *and* 6.9)

Nominal Dimension of the Component		Allowable Tolerances on Dimensions of Holes, *Max*	
Over	Up to and Including	Type A	Type B
(1)	(2)	(3)	(4)
mm	mm		
—	3	±0·3 mm	±0·5 mm
3	5	+0·3 mm −0·4 mm	±0·5 mm
5	10	+0·4 mm −0·5 mm	±1·0 mm
10	20	+0·4 mm −0·6 mm	±1·0 mm
20	30	+0·5 mm −0·7 mm	±1·0 mm
30	50	+0·5 mm −0·8 mm	±2·5 percent but not more than ±2 mm for values above 30 mm
50	80	+0·5 mm −1·0 mm	

NOTE 1 — For unimportant dimensions above 10 mm which do not affect the assembly, the allowable tolerances may be higher than those specified but not more than twice these values.

NOTE 2 — Ovality of the component and also local non-uniformity of the surface shall not make the component cross the dimensions beyond the limits of allowable tolerances.

TABLE 6 TOLERANCES ON NON-PARALLELISM OF PLANE SURFACES

(*Clause* 6.5)

Nominal Distance Between Plane Surfaces of the Component		Allowable Tolerances on Non-parallelism of Plane Surfaces, *Max*
Over	Up to and Including	
(1)	(2)	(3)
mm	mm	
5	20	±0·7 mm
20	30	±0·8 mm
30	50	±1·0 mm
50	80	±1·2 mm
80	120	±1·4 mm
120	180	±1·7 mm
180		±1·0 percent

TABLE 7 WARP IN FLAT SURFACES

(*Clause* 6.6.1)

Length of the Surface		Allowable Warp, *Max*
Over	Up to and Including	
(1)	(2)	(3)
mm	mm	
5	50	0·3 mm
50	80	0·5 mm
80	120	0·8 mm
120	180	1·2 mm
180	250	1·7 mm
250		0·7 percent

TABLE 8 WARP IN BEARING SURFACE

(*Clause* 6.6.2)

Length or Diameter of the Bearing Surface of the Component		Allowable Warp, *Max*
Over	Up to and Including	
(1)	(2)	(3)
mm	mm	
10	30	0·3 mm
30	60	0·5 mm
60	100	1·0 mm
100		1·0 percent

7.2 Storage — The components shall be stored in covered building.

7.3 Marking — Each package consisting of components shall contain the packing list or the delivery note indicating the following details:

a) Supplier's name or trade-mark,

b) Total quantity of components of each drawing or description, and

c) Drawing number or brief description of the components.

7.3.1 The package may also be marked with the Standard Mark.

7.3.2 The use of the Standard Mark is governed by the provision of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7.4 Packages containing components shall be suitably marked with symbols: 'FRAGILE. HANDLE WITH CARE'. 'THIS WAY UP' and 'DO NOT DROP' in accordance with Fig. 1, 3 and 8 of IS : 1286-1967*.

8. TESTS

8.1 Classification of Tests

8.1.1 *Type Tests* — The following shall constitute type tests and shall be carried out in the sequence given below:

a) Visual and dimensional check-up (**8.2**),
b) Heat shock test (**8.3**),
c) Water absorption test (**8.4**),
d) Insulation resistance test (**8.5**), and
e) Mechanical strength test (**8.6**).

8.1.1.1 *Samples for type tests and criteria for conformity* — Type tests shall be applied to 6 components of a given type; in the event of any one component failing to comply with the requirements in any respect, a further set of 12 components shall be taken, all of which shall comply with the requirements of this standard.

8.1.2 *Acceptance Tests* — The following shall constitute acceptance tests and shall be carried out in the sequence given below:

a) Visual and dimensional check-up (**8.2**),
b) Insulation resistance test (**8.5**), and
c) Mechanical strength test (**8.6**).

8.1.2.1 *Sampling plan* — A recommendatory sampling plan and criteria for acceptance of lot is given in Appendix A.

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*Pictorial markings for handling of goods in general (*first revision*).

8.2 Visual and Dimensional Check-Up — The visual inspection shall be carried out with naked eyes. The test samples shall be checked for the following:

a) External defects — in accordance with Table 1, and

b) Accuracy of shape and sizes — The shape and the sizes are checked according to the drawings using instruments having accuracy better than ±0·01 mm.

8.2.1 During the test, the shape and dimensions of the components shall comply with the relevant drawings.

8.3 Heat Shock Test — The test samples shall withstand two cycles of sharp temperature changes, one followed by the other, without widening of the allowable hairline surface cracks and development of new cracks and other surface defects when examined with the naked eye.

8.3.1 The test samples are subjected to two cycles of heating and cooling. Each cycle consists of heating the test samples in water at a constant temperature in the range 70 to 100°C for 15 minutes. After this, the test samples shall be immediately transferred to cold water. The temperature of the cold water shall be 70°C lower than the temperature of water in which the test samples were heated. The quantity of cold water shall be so taken that its temperature shall not rise by more than 2°C after immersion of the heated test samples.

8.3.2 During heat shock test, the component shall not develop any cracks and the existing permissible cracks (*see* Table 1) shall not widen.

8.4 Water Absorption Test — The test samples as received are placed in a container having clean distilled water. The surface level of the distilled water shall be at least 50 mm above the highest point of the immersed test sample. The test samples are kept under water for 24 hours. The water is boiled for the first three hours of immersion taking care that water shall boil within 30 minutes from the time of heating. After boiling, the test samples are cooled along with water for the remaining period of immersion under water.

8.4.1 After 24 hours of immersion under water during which the above boiling has also taken place the test samples are taken out, wiped dry on the surface with a filter paper and their mass taken. They are then dried at 250 ± 5°C for 6 hours and cooled in a desiccator and their mass taken again. The determination of mass is carried out with an accuracy of 0·001 g.

8.4.2 The increase in mass due to water absorption shall not exceed one percent.

8.4.3 The water absorption is calculated by the following formula:

$$W = \frac{M_1 - M_2}{M_2} \times 100$$

where

W = water absorption as a percentage of the mass of dry test samples, calculated up to two decimal places;

M_1 = mass of the test samples after immersion in water; and

M_2 = mass of the dry test samples.

8.5 Insulation Resistance Test

8.5.1 *Apparatus and Conditioning* — Insulation resistance test shall be carried out in a chamber having relative humidity of 95 ± 5 percent. Before the starting of the test, the test samples are kept in this chamber for 48 h.

8.5.1.1 The apparatus for testing insulation resistance consists of a hermetically sealed chamber having two insulators with conductors fixed on its side walls. Through these insulators, connections are made with the test samples and the net by means of wires within the chamber for applying the test voltage. The apparatus is shown in Fig. 1.

8.5.1.2 The temperature of the room in which the chamber is kept shall be 27 ± 5°C. The necessary humidity for testing inside the test chamber is obtained by allowing water to evaporate in it. For this purpose, the level of water in the chamber shall be not less than 20 mm from the bottom.

8.5.1.3 The test sample is placed inside the chamber on a shelf made of net. The shelf is so placed that the distance between the shelf and water level is not less than 30 mm. The internal volume of the chamber shall be not less than 10 times the volume of the test sample and shelf taken together.

8.5.1.4 The test sample and the water to be used are kept for 4 h in the room where the test is to be conducted, and then the test sample is placed in the hermetic chamber. This is done so that they acquire the room temperature.

8.5.2 The measurement of the insulation resistance is conducted at 500 ± 50 V dc between the following points of the test sample:

a) Conducting points of different polarity,

b) Different contacts of the same polarity, and

c) Conducting points connected together and the non-conducting points or the metallic shelf on which the test sample is placed.

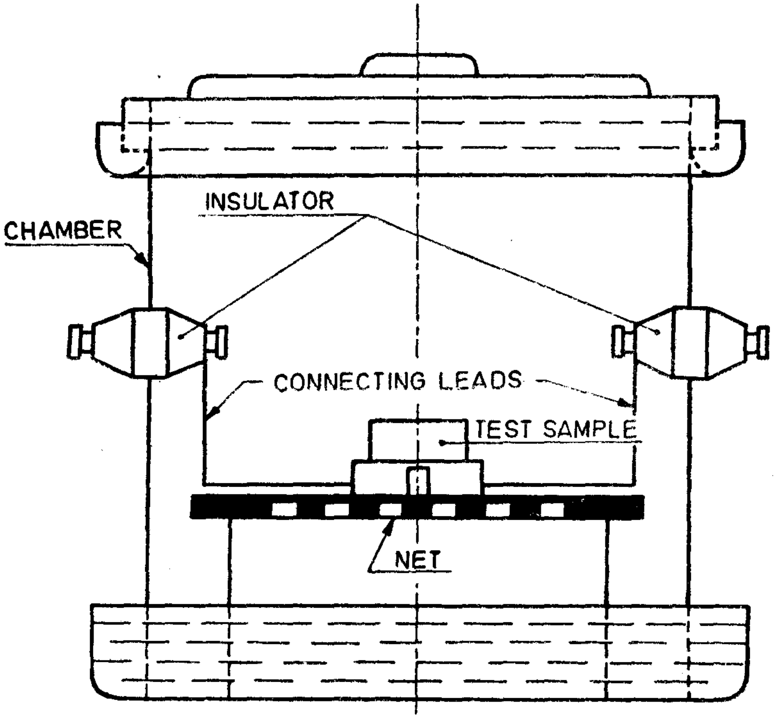

FIG. 1 APPARATUS FOR INSULATION RESISTANCE TEST

8.5.2.1 When testing is to be carried out between conducting and non-conducting points, the non-conducting points are wrapped with aluminium foil.

8.5.3 The insulation resistance of the components shall be not less than 5 MΩ.

8.6 Mechanical Strength Test — The mechanical strength test on the test sample is carried out for a period of 2 h on a transportation jolting test stand having an acceleration of 30 m/s^2 and a frequency of jolt from 80 to 120/min.

8.6.1 When examined with the naked eyes, the test sample shall not show any physical change or cracks on its surfaces.

APPENDIX A

(*Clause* 8.1.2.1)

SAMPLING AND CRITERIA FOR ACCEPTANCE

A-1. LOT

A-1.1 In any consignment all the ceramic components of the same type, shape, size and manufactured from the same material under essentially similar conditions of production shall be grouped together to constitute a lot.

A-1.2 Samples shall be taken from each lot and tested for conformity. Any component failing to satisfy the appropriate requirements shall be considered as a defective.

A-2. SCALE OF SAMPLING

A-2.1 The number of components to be taken from each lot shall be in accordance with col 2 of Table 9. These components shall be taken at random. For this purpose guidance may be taken from IS : 4905-1968*.

A-2.2 In case the components are supplied in wooden cases, crates, bamboo baskets or containers, at least 10 percent of these shall be selected. From each of the selected containers, crates, etc, approximately equal number of components shall be taken at random so as to give the sample size as given in col 2 of Table 9.

TABLE 9 SCALE OF SAMPLING AND CRITERIA FOR ACCEPTANCE

(*Clauses* A-2.1, A-2.2, A-3.1 *and* A-3.2)

Lot Size (Pieces) (1)	Sample Size for Visual and Dimensional Check-Up (2)	Permissible Number of Defectives (3)	Sample Size for Heat Shock, Water Absorption, Insulation, Resistance, and Mechanical Strength Tests (4)	Permissible Number of Defectives (5)
Up to 150	13	0	12	0
151 to 500	32	0	20	0
501 ,, 1 000	50	1	32	0
1 001 ,, 3 000	80	2	52	0
3 001 ,, 10 000	125	3	80	1
10 001 and above	200	5	128	1

---

*Methods of random sampling.

A-3. NUMBER OF TESTS AND CRITERIA FOR ACCEPTANCE

A-3.1 Visual and Dimensional Check-Up — The samples selected according to col 2 of Table 9 shall be tested for visual and dimensional check-up. In case the permissible number of defectives is less than or equal to col 3 of Table 9 the lot shall be considered as conforming to the requirements.

A-3.2 Heat Shock, Water Absorption, Insulation Resistance and Mechanical Strength Tests — From those samples which have conformed for visual and dimensional check-up (*see* **A-3.1**), samples shall be selected at random in accordance with col 4 of Table 9. These samples shall be divided into four groups. One group shall be tested for heat shock, the second group shall be tested for water absorption, the third group shall be tested for insulation resistance and the last group shall be tested for mechanical strength. If a component fails in any one of these tests, it shall be called a defective. If the number of defectives for any one of the groups is equal to or less than the permissible number of defectives given in col 5 of Table 9, the lot shall be considered as conforming to the test.

A-3.3 The lot shall be declared as conforming to the specification if **A-3.1** and **A-3.2** are satisfied.

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